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[Abstract]

[Object] To obtain a double-faced adhesive tape having excellent peelability and free from problems of the breakage of the tape during peeling or the formation of residue of the tacky adhesive on the surface of an adhered in the peeling of the adhesive tape from various adherents such as plastics or metals.

[Solving Means] This double-faced adhesive tape has acrylic pressure-sensitive adhesive layers on both surfaces of a base material. The storage elastic modulus (G') of the acrylic pressure-sensitive adhesive agent is 4.5×10^5 to 6.0×10^5 dyne/cm² at 50°C and the base material is nonwoven fabric solely made of Manila hemp and having the following physical properties (A) to (E). (A) The grain ratio is 80% or more, (B) the tear strength is 50 to 80 gf, (C) the tensile strength is 1 to 2 kgf/15 mm, (D) the elongation difference between the MD direction and the TD direction is 50% or less and (E) the air-permeability is 0.3 sec or less.

[Scope of Claims]

[Claim 1] A double-faced adhesive tape having provided an acrylic pressure-sensitive adhesive on both sides of a backing material, wherein the base material comprises a nonwoven fabric consisting only of Manila hemp having the physical properties A) to E) described below and wherein the acrylic pressure-sensitive adhesive has a storage elastic modulus (G') at 50°C of 4.5×10^5 to 6.0×10^5 dyne/cm²:

- A) the grain ratio being 80% or more;
- B) the tear strength being 50 to 80 gf;
- C) the tensile strength being 1 to 2 kgf/15 mm;
- D) the elongation difference between the MD direction and the TD direction being 50% or less; and
- E) the air-permeability being 0.3 sec or less.

[Claim 2] A double-faced adhesive tape according to Claim 1, wherein a difference between the tensile strength in the MD direction and the tensile strength in the TD direction is 0.5 kgf/10 mm or less and the elongation difference between the MD direction and the TD direction of the double-faced adhesive tape is 30% or less.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs] The present invention relates to a double-faced adhesive tape. More particularly, the present invention relates to a double-faced adhesive tape having excellent peelability and free from the breakage of the double-faced adhesive tape or the formation of residue of the pressure-sensitive adhesive on the surface of an adherend in the peeling of the adhesive tape laminated on various adherends such as plastics or metals therefrom.

[0002]

[Prior Art] Double-faced adhesive tapes are utilized as bonding means having high workability and high reliability on adhesive properties in various industrial fields such as household electrical appliances, automobiles, and OA appliances. Also, in recent years, it is becoming more often the case that recyclable parts used in products are reused by disassembling the products after their use. On this occasion, where the parts are bonded together by using a double-faced adhesive tape, the operation of peeling the double-faced adhesive tape off from the parts on which it has been laminated may be required in some cases.

[0003]

[Problems to be solved by the Invention] However, generally speaking, the operation of peeling a double-faced adhesive tape from an adherend is in many cases difficult to do. For example, in the case of a double-faced adhesive tape including a nonwoven fabric composed of a rayon fiber as a base material, there has been a problem that when the double-faced adhesive tape is pulled at the time of peeling, the tape is immediately broken. Also, a double-faced adhesive tape that has been laminated on an adherend for a long period of time may in some cases be peeled off in a state where the pressure-sensitive adhesive remains on the surface of the adherend (so-called adhesive residue), thus requiring wiping off the pressure-sensitive adhesive remaining on the surface of the adherend with a solvent or the like, which makes the operation of peeling the double-faced adhesive tape difficult.

[0004] On the other hand, as the means for solving the above-mentioned problems, JP 7-70527 A proposes a double-faced pressure-sensitive adhesive tape characterized in that on the both sides of a nonwoven fabric base material mainly made of Manila hemp and having a longitudinal tensile strength of 1 kg/15 mm or more and a transverse tensile strength of 1 kg/15 mm or more is provided a pressure-sensitive adhesive layer, and that the pressure-sensitive adhesive layer on at least one side thereof is a water-soluble pressure-sensitive adhesive layer. However, where this double-faced pressure-sensitive

adhesive tape is peeled off from the adherend, it is necessary to contact the water-soluble pressure-sensitive adhesive layer with water to dissolve the pressure-sensitive adhesive layer in water, which causes a problem that the peeling operation becomes complicated.

[0005] In consideration of the circumstances on the prior art, an object of the present invention is therefor to obtain a double-faced adhesive tape having excellent peelability and free from the breakage of the double-faced adhesive tape or the formation of residue of the pressure-sensitive adhesive on the surface of an adherend in the peeling of the adhesive tape laminated on various adherends such as plastics or metals therefrom.

[0006]

[Means for solving the Problems] The inventors of the present invention made extensive studies with a view to solving the above-mentioned problems, with the result that they have found that the above-mentioned problems can be solved by fabricating a double-faced adhesive tape by combining a nonwoven fabric solely made of Manila hemp pulp having specific physical properties with an acrylic pressure-sensitive adhesive having a storage elastic modulus (G') in a specific range, thus achieving the present invention.

[0007] Therefore, in order to attain the above-mentioned problem, according to the present invention, there is provided a double-faced adhesive tape having provided an acrylic pressure-sensitive adhesive on both sides of a backing material, wherein the base material comprises a nonwoven fabric consisting only of Manila hemp having the physical properties A) to E) described below and wherein the acrylic pressure-sensitive adhesive has a storage elastic modulus (G') at 50°C of 4.5×10^5 to 6.0×10^5 dyne/cm²:

A) the grain ratio being 80% or more;

B) the tear strength being 50 to 80 gf;

C) the tensile strength being 1 to 2 kgf/15 mm;

D) the elongation difference between the MD direction and the TD direction being 50% or less; and

E) the air-permeability being 0.3 sec or less.

[0008] Further, it is preferable that, in a double-faced adhesive tape according to the present invention, a difference between the tensile strength in the MD direction and the tensile strength in the TD direction is 0.5 kgf/10 mm or less and the elongation difference between the MD direction and the TD direction of the double-faced adhesive tape is 30% or less.

[0009]

[Embodiment Mode of the Invention] In the present invention, a nonwoven fabric solely made of Manila hemp is used as the base material of a double-faced adhesive tape. Here, by the

nonwoven fabric solely made of Manila hemp, it is meant the one in which as the raw material for constituting the nonwoven fabric is used solely Manila hemp fibers and the means for connecting the fibers to each other is provided only by the entanglement of Manila hemp fibers with each other, but no resin impregnation treatment using viscose, for example, as usually done for connecting the fibers to each other in producing nonwoven fabrics has been effected. The inventors of the present invention have found that when a pressure-sensitive adhesive is coated on the above-mentioned nonwoven fabric solely made of Manila Hemp, the pressure-sensitive adhesive invades in the interstices between the fibers more easily than in the nonwoven fabric subjected to the usual resin impregnation processing and the pressure-sensitive adhesive serves as a binder for binding the fibers to each other, with the result that the strength of the double-faced adhesive tape can be increased.

[0010] Furthermore, the nonwoven fabric solely made of Manila hemp used as the base material of the double-faced adhesive tape of the present invention (hereinafter, referred to simply as "nonwoven fabric") is fabricated by the above-mentioned method and must have all of the physical properties A) to E) described below.

[0011] A) The grain ratio of the nonwoven fabric is 80% or more, preferably 90 to 100%. If the grain ratio is smaller than 80%, the isotropy of the strength or elongation in the MD direction and TD direction of the nonwoven fabric is lost; when such a nonwoven fabric is used as the base material of a double-faced adhesive tape, it will be a cause of the increase in probability of the double-faced adhesive tape breakage along the direction in which the strength the nonwoven fabric is weak when the double-faced adhesive tape is peeled off from the adherend. Note that in the present invention, by the grain ratio is meant a ratio of the tensile strength of the nonwoven fabric in the MD direction to the tensile strength of the nonwoven fabric in the TD direction.

[0012] B) The tear strength of the nonwoven fabric is 50 to 80 gf. If the tear strength is smaller than 50 gf, the double-faced adhesive tape laminated on an adherend tends to be broken when it is peeled off therefrom, as in the case of the conventionally used nonwoven fabric. Also, if the tear strength is larger than 80 gf, the impregnating ability of a pressure-sensitive adhesive into a nonwoven fabric at the time of adhesion processing becomes worse since the fiber density of the nonwoven fabric is increased and in particular, this becomes a cause of remaining pressure-sensitive agent on the surface of an adherend when the double-faced adhesive tape is peeled off from the adherend. Here, the tear strength of the

nonwoven fabric was measured in accordance with the JIS-P-8116 method.

[0013] C) The tensile strength of the nonwoven fabric is 1 to 2 kgf/15 mm. If the tensile strength is smaller than 1 kgf/15 mm, the double-faced adhesive tape laminated on an adherend tends to be broken when it is peeled off therefrom, as in the case of the conventionally used nonwoven fabric. Also, if the tensile strength is larger than 2 kgf/15 mm, the impregnating ability of a pressure-sensitive adhesive into a nonwoven fabric at the time of adhesion processing becomes worse since the fiber density of the nonwoven fabric is increased and in particular, this becomes a cause of remaining pressure-sensitive agent on the surface of an adherend when the double-faced adhesive tape is peeled off from the adherend. Here, the tear strength of the nonwoven fabric was measured in accordance with the JIS-P-8113 method.

[0014] D) The elongation difference of the nonwoven fabric between the MD direction and the TD direction is 50% or less, preferably 30% or less, more preferably 0%. Here, the elongation difference between the MD direction and the TD direction is meant a value obtained by substituting a value of the elongation in the MD direction (flow direction) and a value of elongation in the TD direction (width direction) of a nonwoven fabric measured in accordance with the JIS-P-8132 method into the formula 1 described below. It is preferred that the nonwoven fabric used in the present invention has identical elongation in the MD direction and TD direction. Specifically, the elongation difference between the MD direction and the TD direction must satisfy the above-described requirement. In the case where a nonwoven fabric whose elongation difference between The MD direction and the TD direction does not satisfy the above-described requirement is used as the base material of a double-faced adhesive tape, it may in some cases become a cause of easy breakage of the tape when the double-faced adhesive tap is peeled off from an adherend or a cause of deterioration of size stability when the double-faced adhesive tape is processed.

[0015]

[Eq.1]

Elongation difference between MD direction and Td direction (%) = |elongation of MD direction (%) - elongation of TD direction (%)| / {elongation of MD direction (%) + elongation of TD direction (%)}/2 X 100 (Formula 1)

[0016] E) The air-permeability of the nonwoven fabric is 0.3 sec or less, preferably 0.2 sec or less. If the air-permeability of the nonwoven fabric is larger than 0.3 sec, the impregnating ability of a pressure-sensitive adhesive when

it is coated to the nonwoven fabric is decreased and the strength of the double-faced adhesive tape may in some cases become insufficient. Note that the air-permeability of the nonwoven fabric was measured by the JIS-P-8117 method.

[0017] The nonwoven fabric to be used in the present invention must satisfy all of the physical properties prescribed in A) to E) described above; in the case where a part of the physical properties prescribed in A) to E) described above is satisfied but the other physical properties do not coincide, a double-faced adhesive tape satisfying the peelability and adhesive residue property can no longer be obtained.

[0018] The thickness of the nonwoven fabric is not particularly limited but it is preferred that it is usually 80 μm or less, in particular 30 to 60 μm .

[0019] For the pressure-sensitive adhesive to be provided on both sides of the nonwoven fabric, it is necessary that the pressure-sensitive adhesive does not remain on the surface of an adherend when the double-faced adhesive tape is peeled off therefrom, even when the double-faced adhesive has been laminated on the adherend for a long period of time. The inventors of the present invention have made various studies in view of the above-mentioned points and as a result, they have found that acrylic pressure-sensitive adhesives are advantageous as compared with rubber pressure-sensitive adhesives in the present invention, and further that among the acrylic pressure-sensitive adhesives, a pressure-sensitive adhesive that has a storage elastic modulus (G') at 50°C in the specific range as defined below is extremely effective in preventing the phenomenon of adhesive residue.

[0020] That is, in the double-faced adhesive tape of the present invention, the acrylic pressure-sensitive adhesive to be provided on the both sides of the nonwoven fabric must have a storage elastic modulus (G') at 50°C of 4.5×10^5 to 6.0×10^5 dyne/cm². By using the acrylic pressure-sensitive adhesive having a storage elastic modulus at 50°C in the above-mentioned range, the double-faced adhesive tape can be peeled without causing adhesive residue even when the double-faced adhesive tape has been laminated on the adherend for a long period of time. If the storage elastic modulus (G') at 50°C is less than 4.5×10^5 dyne/cm², where a double-faced adhesive tape has been laminated on an adherend for a long period of time, the connecting force (adhesive force) at the interface of adherend becomes greater than the cohesion of the inside of the pressure-sensitive adhesive, so that the pressure-sensitive adhesive layer causes cohesion failure when the double-faced adhesive tape is peeled off from the adherend, so that the phenomenon of adhesive residue tends to occur. Also, if the

storage elastic modulus (G') at 50°C is above 6.0×10^5 dyne/cm², the pressure-sensitive adhesive is too hard and the adhesive properties are decreased, which is not preferable.

[0021] The acrylic pressure-sensitive adhesive is not particularly limited so far as the value of storage elastic modulus (G') at 50°C is within the range prescribed above and known acrylic pressure-sensitive adhesives are used as appropriate. As such an acrylic pressure-sensitive adhesive, there is used, for example, an acrylic polymer composed of a copolymer of an alkyl (meth)acrylate and another unsaturated monomer that is copolymerizable therewith, optionally blended with additives such as a crosslinking agent and a tackifier resin.

[0022] Note that in the present invention, the storage elastic modulus (G') of an acrylic pressure-sensitive adhesive corresponds to storage elastic modulus in shear of the above-mentioned acrylic pressure-sensitive adhesive, which is a value measured by using a dynamic viscoelasticity measuring apparatus RDS-II manufactured by Rheometric Co., with an acrylic pressure-sensitive adhesive having a thickness about 1.5 mm as a sample and a jig of parallel plates of 7.9 mm in diameter at a frequency of 1 Hz.

[0023] The double-faced adhesive tape of the present invention has a structure in which an acrylic pressure-sensitive adhesive layer is provided on both sides of a nonwoven fabric. As a production method for the double-faced adhesive tape, there is used a known method as appropriate. The production method includes, for example, a direct coating method, in which an acrylic pressure-sensitive adhesive is directly coated on a nonwoven fabric and dried, a transfer method, in which an acrylic pressure-sensitive adhesive is coated on a peeled-off liner and dried, and then laminated on a nonwoven fabric, and so on.

[0024] It is preferred that the thickness of the acrylic pressure-sensitive adhesive layer to be provided on the nonwoven fabric is usually 30 to 100 μm , in particular 50 to 80 μm .

[0025] It is desirable that the double-faced adhesive tape of the present invention has a difference between the tensile strength in the MD direction and the tensile strength in the TD direction of the double-faced adhesive tape of 0.5 kgf/10 mm or less, preferably 0 kgf/10 mm, and an elongation difference between the MD direction and the TD direction of the double-faced adhesive tape of 30% or less, preferably 0%. Here, the elongation difference between the MD direction and the TD direction corresponds to a value calculated by substituting a value of the elongation in the MD direction and

a value of elongation in the TD direction of a double-faced adhesive tape measured, into Expression (1) described above in accordance with the measurement method described hereinbelow. In the case where the physical properties, i.e., tensile strength and elongation, of the double-faced adhesive tape exceed the ranges prescribed above and are greatly different between the MD direction and the TD direction, there may occur some cases where the double-faced adhesive tape is easily broken when the double-faced adhesive tape is peeled off from the adherend.

[0026]

[Example] Hereinafter, the present invention will be described by way of examples. However, the present invention is by no means limited to these examples.

[0027] (Example 1) A nonwoven fabric solely made of Manila hemp (grain ratio, 90%; tear strength, 60 gf; tensile strength, 1.5 kgf/15 mm; elongation difference between the MD direction and the TD direction, 10%; air-permeability, 0.15 sec; thickness, 50 μ m) was coated on both sides thereof with an acrylic pressure-sensitive adhesive having a storage elastic modulus (G') at 50°C of 5.0×10^5 dyne/cm², each side coated to a thickness of 55 μ m (total thickness of the double-faced adhesive tape 160 μ m), to fabricate a double-faced adhesive tape of the present invention.

[0028] (Comparative Example 1) A double-faced adhesive tape was fabricated in the same manner as in Example 1 except that a nonwoven fabric having a thickness of 50 μ m composed of rayon fibers was used as the base material.

[0029] (Comparative Example 2) A double-faced adhesive tape was fabricated in the same manner as in Example 1 except that an SIS rubber pressure-sensitive adhesive was used as the pressure-sensitive adhesive.

[0030] Evaluations as shown below were made on the double-faced adhesive tapes obtained in Example and Comparative Examples.

[0031] <Tensile Strength and Elongation of Double-faced Adhesive Tapes> Samples in 10 mm width were broken from each double-faced adhesive tape in the MD direction (flow direction) and the TD direction (width direction). By using a tensile strength tester, the double-faced adhesive tape was pulled at a clamping jaws distance of 50 mm, and a tension speed of 50 mm/min, and the strength (tensile strength) and elongation at the time when the double-faced adhesive tape was broken were measured.

[0032] <Adhesive force/Peelability/Adhesive residue> A sample of a double-faced adhesive tape having laminated on one side thereof a 5-mm thick urethane foam was cut to a width of 20

mm. The sample was pressed on an SUS-304 plate surface ground with a sandpaper (#280) by one reciprocating motion of a roller under a load of 2 kg, and then left to stand at ambient temperature for 30 minutes. Thereafter, this was further placed in a sunshine weather meter for one month. Then, the sample was taken out from the sunshine weather meter and aged at ambient temperature, followed by measurement of adhesive force by using a tensile strength tester at a tension speed of 300 mm/min by 180° peeling in accordance with the JIS-Z-0237 method. On this occasion, evaluation was performed as follows. The peelability when the double-faced adhesive tape was broken during the peeling was assigned X. Also, the adhesive residue when it was peeled off in a state where the pressure-sensitive adhesive remained on the surface of the SUS-304 plate was assigned X.

[0033] Evaluation results are shown in Table 1.

[0034]

[Table 1]

| | Tensile strength [kgf/10mm] | | Elongation [%] | | Adhesive Force [g/20mm] | Peelability | Adhesive Residue |
|-----------------------|--------------------------------|------|-------------------|-----|----------------------------|-------------|------------------|
| | MD | TD | MD | TD | | | |
| Example 1 | 2.0 | 1.95 | 4.5 | 5.0 | 2100 | O | O |
| Comparative example 1 | 1.2 | 0.6 | 0.5 | 0.5 | 2000 | X | O |
| Comparative example 2 | 1.8 | 1.8 | 4.0 | 4.2 | 1600 | X | X |

* Peelability: O ... No breakage of tape, X ... Breakage of tape

* Adhesive Residue: O ... No adhesive residue, X ... Adhesive residue

[0035] As will be apparent from Table 1, the double-faced adhesive tape of Example 1, in which the nonwoven fabric solely made of specific Manila hemp and the specific acrylic pressure-sensitive adhesive prescribed in the present invention has high adhesive force whereas the double-faced adhesive tape is not broken during the peeling. Furthermore, even after the double-faced adhesive tape has been laminated on an adherend, the tape can be peeled off therefrom without allowing the pressure-sensitive adhesive to remain on the surface of the adherend.

[0036]

[Effect of the Invention] Since the double-faced adhesive tape of the present invention has the above-described construction, in the case where the double-faced adhesive tape laminated on various kinds of adherends is peeled off therefrom, there will not occur a case where the double-faced adhesive tape is broken in the midway of the peeling or the pressure-sensitive

adhesive is allowed to remain on the adherend. Therefore, the double-faced adhesive tape that is laminated on a part or the like and is no longer necessary can be easily peeled off by a usual peeling operation. In particular, the double-faced adhesive tape of the present invention, like products using recyclable parts, can save a labor of peeling operation in the case where there is needed an operation of peeling the tape off from parts on which the double-faced adhesive layer has been laminated for a long period of time.